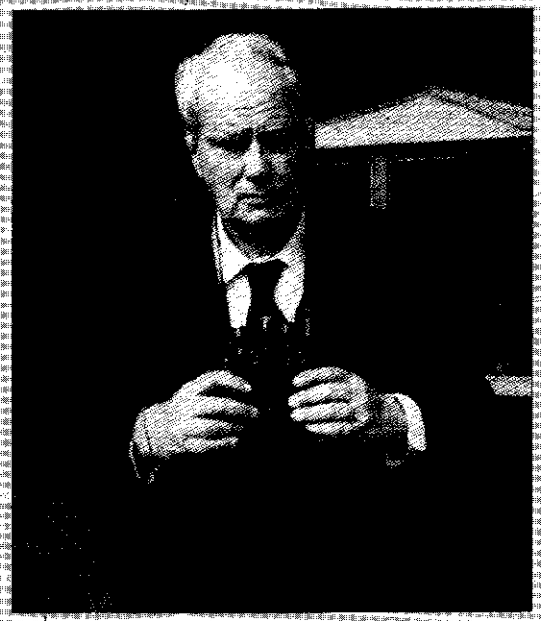
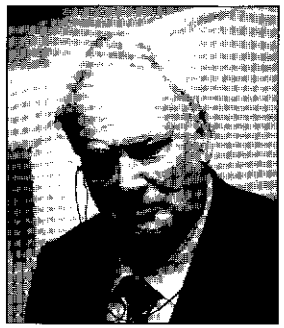
First Steps in Astronomy



By Patrick Moore

Sponsored by Broadhurst, Clarkson & Fuller and Astronomy Now

This booklet is an attempt to provide an answer to some of the many letters I receive asking how to make a start in astronomy. There are too many questions to be answered; how to learn one's way around the night sky, what books to read, methods of observation, what can be seen with telescopes or binoculars, the importance of local and national astronomical societies, and many general hints.



Most people have at least a passing interest in astronomy. The skies are all around us; even the most myopic observer cannot fail to notice the Sun, the Moon and the stars! But astronomy as a serious hobby is another matter, and I receive countless letters asking me how to 'make a start'. This booklet is an attempt to provide an answer.

Patrick Moore

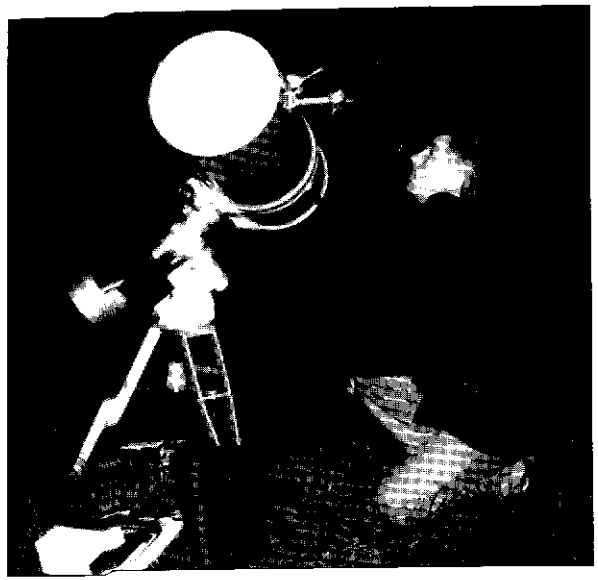
Getting started

Let it be said at the outset that astronomy as a hobby, and astronomy as a career, are two different things. To become a professional scientist means taking a degree, and there is no short cut. I will return to this point later. But no qualifications are needed to become an amateur astronomer, and it is quite true to say that astronomy is the one science in which the amateur can still carry out valuable research. In fact, the results of amateurs are widely used by professionals, even in this age of complicated technology.

The modern amateur can be very well equipped with all manner of computers and electronic devices. But I am here writing for the complete beginner, who just about knows the difference between an asteroid and an adenoid, but who is quite ignorant of any technical points. First I shall say a little about my own initial steps, because I still think that I went about things the right way.

I was six years old when I first became an enthusiast (this goes back to the distant period of 1929!) I picked up a book belonging to my mother, who had rather more than a mild interest in the subject even though she never took it up seriously. The book was not actually written for boys, but I did not have a reading problem, and I devoured the book at one sitting. I decided that it was interesting, and I combed the bookcase for another, which I found and which I read with equal fascination. Parts of it were beyond me, but at least I had been 'fired', and from that day onward astronomy became a part of my life.

I am sure that this must be the starting-point. Today there are many books – far more than there were in 1929, when astronomy was still regarded as a 'way out' study divorced from everyday life – and the first essential is to do some reading and absorb the main facts.



A typical medium-size enthusiast's 'scope in action.

My next step was to obtain an outline star-map, and begin finding my way around the sky. Naturally, I knew nothing about the star patterns, and I assumed that it would take me a long time to learn the difference between one constellation and another. I was wrong; it is surprisingly easy. After all, there are only a few thousands of stars visible with the naked eye, and the patterns never change; it is only our near neighbours, the members of the Solar System, which shift around from one part of the sky to another.

My method was quite straightforward. From my books I had found out that there are two constellations which are particularly easy to recognise, Ursa Major (the Great Bear or Plough) and Orion (the Hunter). Ursa Major never sets over any part of Britain, though Orion is out of view for part of the year. Very well, then; I would persuade someone to show me these two 'guides', and then use them to identify the rest of the star groups. It happened to be winter, so that both my 'guides' were visible.

I remember beginning with Orion. Follow the line of the Belt downward, and you will come to Sirius, the brightest star in the sky; upward, the Belt leads to Aldebaran in Taurus (the Bull), and so on. I made a pious resolve to identify one new constellation on every clear night – and it worked. Starting with only those two 'guides', it is possible to find all the other groups.

It is a method which I recommend strongly, because the stars become so much more fascinating when you know which one is which. After a few week's practice, you will know the constellations as well as you know the streets in your home town or village.

My next step was to think about optical aid. I began with a pair of binoculars, and introduced myself to coloured stars, star clusters and nebulae. I then turned my thoughts toward acquiring a telescope. Prices in those days were very different from those of the present time, and after saving up very hard I managed to buy a 3-inch

(7.5cm) refractor which I still have and which I still find useful. It cost me £7 10/-. Nowadays the same telescope would cost more like £400, and this initial outlay often causes severe problems to the beginner, about which I will say no more here; it will be covered in our companion booklet, "How To Choose a Telescope" (to be published soon). With my refractor, I began what I regarded at the time as serious observing, and my notebooks date back to 1930.

I lived in Sussex, a mile from the town of East Grinstead, which was at least sufficiently in the country to be free of any glaring artificial lights, but I could find no others who shared my interest in the stars, and there was certainly no local astronomical society. Had there been, I would have joined it. As things were, I had to wait a few years, but then I had a stroke of luck, as a family friend was a leading member of the British Astronomical Association, and when I was eleven he proposed me for membership.

That, really, was the turning point, and I never looked back. I stress this because in my view it is worth joining some sort of society as soon as possible, and today most towns have their local organisations – as you will see from the regular Society News pages in *Astronomy Now*. A full list is given annually in the *Yearbook of Astronomy*, and you will be very unlucky not to find at least one society within accessible range. Moreover, some societies have their own observatories, and many members have telescopes which they are willing to make available to new recruits.

Early on I began to realise that my main interest was in the Solar System, and particularly in the Moon, which at that stage was almost totally neglected by professionals as being hopelessly dull and parochial. (The idea of lunar travel, either by automatic probes or by manned vehicles, was regarded as wild science fiction.) So I decided to specialise, and the Moon has remained my main target to this day. As a final personal note, I may add that I never had any real intention of becoming a professional astronomer. I had found out that a good knowledge of mathematics is absolutely essential, and I am very far from being a natural mathematician, so that I was from the outset content to remain an amateur. With my 3-inch refractor I actually published my first paper about lunar features in 1937, but it was not until after the end of the war, when I emerged from flying with the RAF, that I acquired my first large telescope, a 12.5-inch (31cm) Newtonian reflector, which has been in constant use ever since.

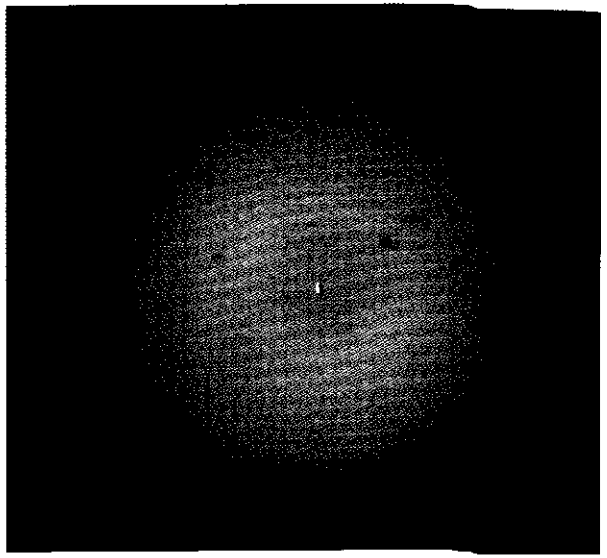
So much for the preliminaries. Now let me deal with each of the different branches of observation in turn and see where they lead us.

The Sun

With a simple telescope it is easy to see the sunspots and faculae, but there are dangers here, and I do not apologise for repeating a warning that I have given more times than I can count.

LOOKING DIRECTLY AT THE SUN THROUGH ANY TELESCOPE, OR BINOCULARS, MUST BE AVOIDED AT ALL COSTS.

You will focus the solar light and heat on to your eye, and destroy your sight; I have known three cases of people who have blinded themselves in this way. Unfortunately, some manufacturers still supply telescopes equipped with dark filters which, it is claimed, can be fitted over the eyepiece for direct viewing. Actually, no filter can give proper protection, and it is always liable to splinter without warning, giving the observer no time to remove his eye from the danger zone. There is only one golden rule for looking straight at the Sun: don't.



Sunspots. Never look directly at the Sun. Projection of the image is a much safer method.

The obvious method is to project. Align your telescope with the Sun by squinting along the top of the tube, or by using shadows – preferably with a cap firmly over the end of the tube. Then send the image on to a white card or screen, held or fastened behind the eyepiece. Any sunspots or faculae which are on view will be excellently seen. It is true that there are some devices (Herschel wedges, and Mylar filters) which can be used, but I am always wary of them – you can put me down as a coward – and never experiment with them until you are sure that you know precisely what you are doing.

On your screen, the spots can be drawn in, and with a Porter's disc the positions can be measured quite accurately. It is fascinating to follow the groups as they are carried across the Sun's face from day to day by virtue of the solar rotation. Obviously you can take photographs of the projected image (though it is awkward to get the camera into a suitable position) and drawings of the spots can be very detailed. For any solar observation a refractor is better than a reflector, but you do not need a large aperture, because there is plenty of light available. Even a very small telescope is useful here; a 3-inch is ideal. With a larger telescope it is wise to stop down the aperture.

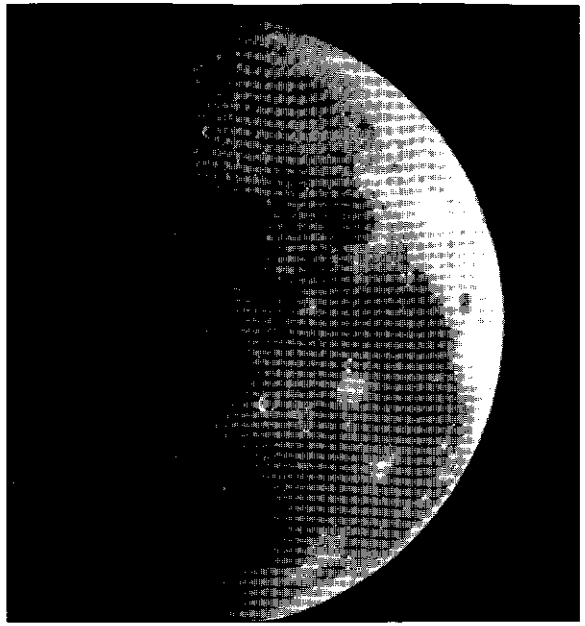
More serious observers will use spectroscopic equipment or Lyot filters, and the prominences become available, but this comes well after you have made a start and learned your way around.

The Moon

Here there is no danger, because the Moon sends us virtually no heat. With low power on a large telescope you may dazzle yourself for a few moments, but you can

do your eyes no damage. Moon filters can be obtained to fit over the eyepiece and cut down the light – but never use them to look at the Sun!

Any small telescope, or good binoculars, will show the lunar features well. The waterless 'seas', the craters, mountains, valleys, hills, domes and rills are magnificent, but again there are pitfalls. Full Moon is the very worst time to begin observing, because there are almost no shadows, and the craters are hard to identify unless they are exceptionally bright-walled or exceptionally dark-floored; the whole scene is dominated by the bright rays, particularly those associated with the craters Tycho and Copernicus. It is better to start when the Moon is in crescent, half, or gibbous phase.



A beautiful half Moon.

Outline maps are easy to obtain, and the first step is to familiarise yourself with the lunar surface. The aspect of a crater will change markedly from one night to another, as the Sun rises or sets over it and the shadows shift and change. A crater is most conspicuous when it is near the terminator – the boundary between the sunlit and night hemispheres – because its floor will be wholly or partly shadowed. My own method was to decide to make at least three sketches of every formation named in my outline map, choosing different stages of illumination. Do not use too small a scale; any attempt to draw, say, the Mare Imbrium at one session is doomed to failure, and it is prefereble to select a limited area and draw it to a larger scale. For example, the crater Plato is 60 miles (96km) in diameter. When sketching across it, I suggest making the major axis about one inch across.

Before the age of space research, the emphasis was upon lunar cartography, both by sketching and by photography; the libration areas – near the edge of the disc – were of special interest. Today, of course, lunar mapping has been to all intents and purposes completed, and the various space probes, manned and unmanned, have provided detailed charts of the entire surface. Therefore, it is sometimes claimed that the Earth-based observer has nothing useful left to do.

This is not quite correct. In particular, there are observations of what are termed TLP, or Transient Lunar Phenomena. Many reports have been received of very short-lived, localised glows and obscurations in certain areas of the Moon which are widely attributed to gaseous emissions from below the surface. In 1958 the Russian astronomer N.A. Kozyrev even obtained a spectrogram of a red 'event' in the crater Alphonsus, and in 1985 a bright 'event' near the crater Proclus was photographed by the Greek observer G. Kolovos. TLP have caused wide controversy, but in any case they provide the serious observer with a challenge which is well worth following up. To go into further details here would take too much space, but the Lunar Section of the British Astronomical Association has a department dealing entirely with TLP research.

Then, of course, there are occultations. Timing the moment when a star is covered by the advancing limb of the Moon is still important – particularly with 'graze occultations', when the Moon skirts the star and there may be several immersions and emersions as the star passes along the lunar limb. Amateurs can be particularly useful here, because the 'graze line' is very narrow, and it is a question of taking an adequate telescope to the critical area; in many cases a 3-inch (7.5cm) refractor will do very well.

The planets

From time immemorial, the planets have been regarded as the amateur's main hunting-ground. Before the Space Age, very little physical observation of planetary surfaces was being carried out professionally – and one has to admit that this is the one part pf astronomy in which the visual observer scores heavily over the Earth-based photographer.

Mercury

Mercury, frankly, is not very rewarding. It is visible with the naked eye only for limited periods, either very low in the west after sunset of very low in the east before sunrise, and many people have never seen it at all. Telescopically it shows a phase, but surface markings are impossible to make out without large telescopes – and even then with difficulty. However, it is always a source of satisfaction to locate this elusive little world. Finding it in the daytime is not very easy unless you have a telescope equipped with accurate setting circles. 'Sweeping around' is emphatically not to be recommended, because of the danger that the Sun will enter the field of view by mistake.

Venus

Venus is a different proposition. Any telescope will show the phase (as, indeed, will good binoculars), but surface features are very indefinite simply because the planet is permanently cloud-covered; all that can be made out are vague patches which shift and change from one day to another. However, there are two lines of investigation which are well worth following up. One is the 'phase anomaly' or Schröter effect. The observed phase is never quite the same as predicted by theory; when Venus is waning as an evening object, dichotomy (exact half phase) is always early, while

Venus imaged in Ultra-violet light. This technique is at the moment only available to professional astronomers.

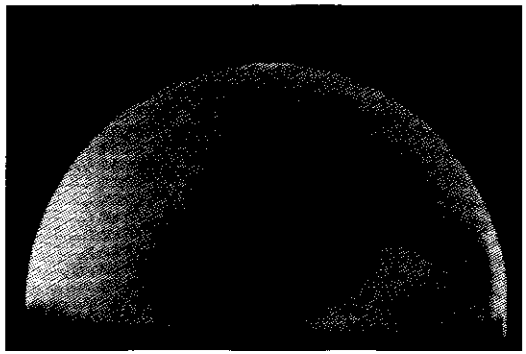
when Venus is a waxing morning object dichotomy is late. The discrepancy may amount to several days. Presumably it is due to the effects of Venus' atmosphere, and it is not confined to the period of dichotomy, but we do not know as much about it as we would like, and observations are useful.

Secondly, there is the Ashen Light, or faint luminosity of the 'night' atmosphere. There can be little doubt of its reality, but it is difficult to observe because it is on view only during the crescent phase. The best method is to remove the bright crescent by means of an occulting device; the special device constructed by Dudley Fuller is ideal (see *Astronomy Now July 1988 p88*. Whether or not the Light is basically auroral, in which case it will be affected by solar activity, is not known; we would like to find out.

Mars

Mars is a favourite object, but, surprisingly is not so easy to observe seriously as might be thought. Generally it has a small apparent diameter, and one has to use fairly high magnifications – though, as always, the observer who finds that definition is falling away should promptly change to a lower power. A 3-inch (7.5cm) refractor will show the polar caps and the main dark markings, though it is probably true that for any useful observations an aperture of at least 6 inches (15cm) is essential. The larger the telescope, the more you will see under favourable conditions. (*En passant*, some observers claim that if conditions are not good, it is helpful to stop down the aperture. I can only say that I have never found this beneficial. If conditions are poor, then the wisest course is to stop observing; faulty results are not only useless, but are actually misleading.)

Mars has always been a major attraction and it is possible to follow the progress of its seasons.



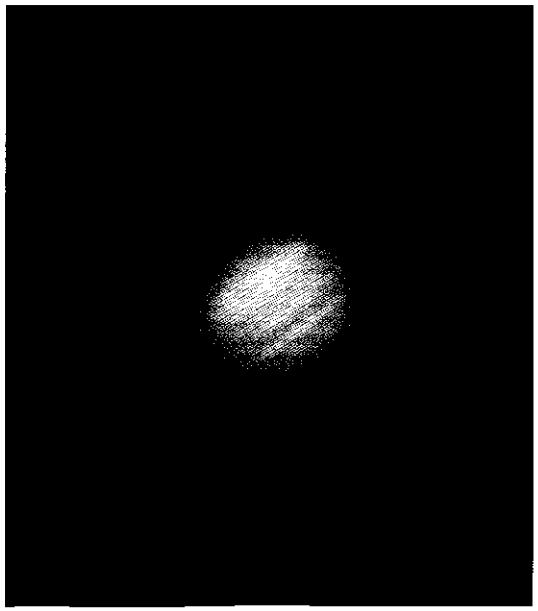
Because Mars shows a distinct phase when away from opposition, it is best to make sketches accordingly. Prepared blanks will help; they can be photocopied, and used for the appropriate phase.

The recommended method is to sketch in the main features first, bearing in mind that the rotation of the planet causes a perceptible 'drift' even over short periods; then change to a higher power and fill in the fine detail. Then, as with all observations, add the following data: date, time (GMT; never use Summer Time), name of observer, type of telescope, aperture, magnification and seeing conditions – using the Antoniadi scale, from 1 (near perfect) down to 5 (so poor that one would not observe at all except for some special reason). For Mars, then add the longitude of the central meridian, which can be worked out from tables such as those given in the *Handbook of the British Astronomical Association*. If any of these data are omitted, the observation loses some or all of its value. For Mars, look especially for cloud phenomena.

Mars is now being monitored by the Mars Observer spacecraft, which arrived at the end of August 1993.

Jupiter

Jupiter is very rewarding, because there is so much to see, and the surface is always changing. Because the planet is flattened, sketches should be made accordingly, and again a blank can be used.



Jupiter photographed by an enthusiast, Mr Chris Campbell of Hornchurch, Essex, using a 6-inch refractor. Views in smaller 'scopes will not be as spectacular.

The rotation is rapid, so that the main features should be drawn in as quickly as is consistent with accuracy; then use a higher power to fill in the fine details, without altering the original sketch. Note intensities, colours and any special features. One very important line of research is to determine rotation periods; wait until the feature concerned comes to the central meridian, and time it as accurately as you can, after which the longitude can be worked out from tables. It is surprising how precise you can be. For many years I worked together with two very famous observers of Jupiter, Bertrand Peek and W.E. Fox. Our transit timings seldom differed by more than 30 seconds, even though I lay no claim to being keen eyed.

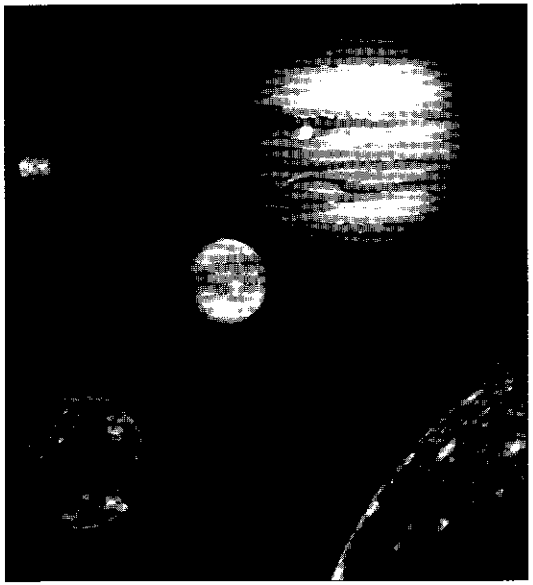
Saturn

Saturn is more of a problem to draw. Blanks can be a great help, though of course the ring angle alters quite markedly even over a single opposition. Look, in particular, for any unusual features on the disc of the planet; a most spectacular outbreak, the Great White Spot of 1933, was discovered by the famous amateur W.T. Hay (Will Hay, the actor). More recently, another white spot appeared in 1990. Because outbreaks of this kind are so rare, the persistent amateur has the best chance of discovering them.

Saturn usually bears high powers quite well, and much can be done with a telescope of modest aperture – say a 6-inch (15cm). Even a much smaller telescope will show the rings, and there can be little doubt that Saturn is the most beautiful object in the entire sky.

Fainter bodies of the Solar System

These include planetary satellites, asteroids, and of course the remote planets Uranus, Neptune and Pluto. The Galilean satellites of Jupiter are so bright that any telescope will show them, and it is fascinating to follow their eclipses, transits and shadow transits. Of Saturn's retinue, Titan is easy enough; a 6-inch will also show several others (Iapetus, Rhea, Dione and Tethys); the rest are more elusive.



A computer composite image of moons of Jupiter, taken by the Voyager probe. The Galilean moons can be seen through any telescope, though not so close up!

Asteroids are of increasing importance nowadays, and there is useful work to be done by measuring their magnitudes in the same way as is recommended for variable stars (see later). As asteroids rotate, their magnitudes change, though admittedly the fluctuations are usually too slight to be noted visually, and some sort of photometer is needed.

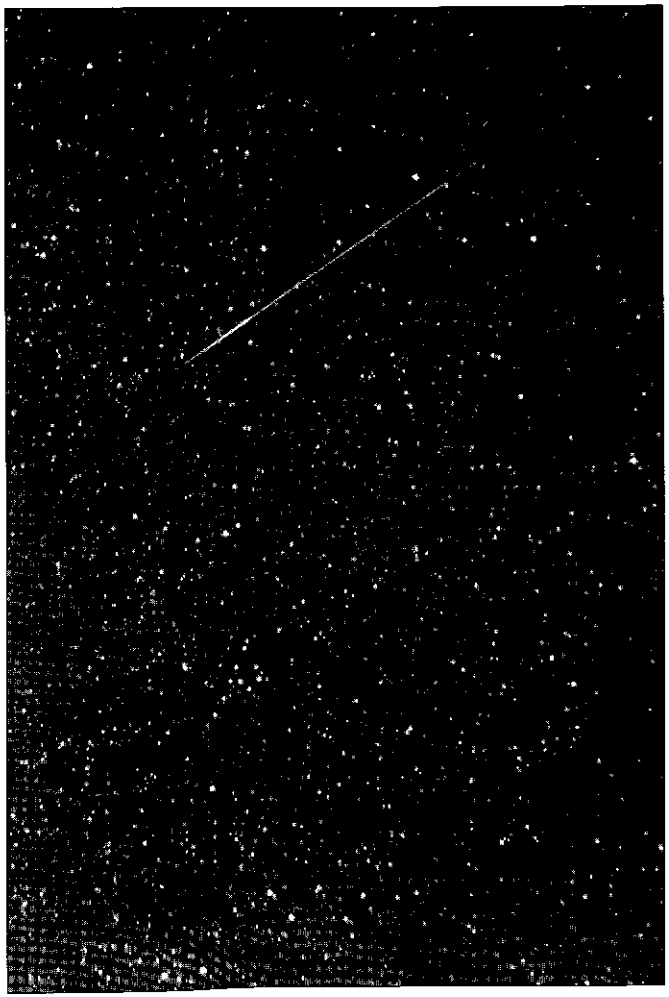
Uranus is easy to locate, and shows a distinct disc; Neptune is above the 8th magnitude; Pluto is within the range of an 8-inch (20cm) telescope. The occasional occultations of stars by these planets, and also by asteroids, are of importance, and again the well-equipped amateur can make major contributions, though an aperture of at least 8 inches (20cm) is needed in most cases.

Meteors

Here the naked eye observer comes into their own, and visual work is still valuable despite the advent of radar. Meteor watching is usually best done as a member of a team, though the isolated observer is not to be despised.

The main showers are, of course, predictable, though bear in mind that sporadic or non-shower meteors may appear from any direction at any moment. Systematic observation is very time-consuming (particularly since the period from midnight to dawn is the most favourable, as we are then on the 'leading edge' of the Earth so that metoers enter the atmosphere at relatively higher velocities), but it is fascinating.

Meteors are exciting to watch with the naked eye. In good weather, the main showers can provide a spectacular display.



Points to note are: Track of the meteor, whether it is the member of a 'shower' or if sporadic, the precise time, magnitude, colour (if any), and any special features, such as 'bursts' and trail.

The best piece of auxiliary equipment is a stick or ruler! Hold this up against the sky along the track of the meteor, and determine the positions of appearance and extinction. Obviously, a proper knowledge of the star patterns makes things a great deal easier and more reliable, though even an approximate position is often better than nothing.

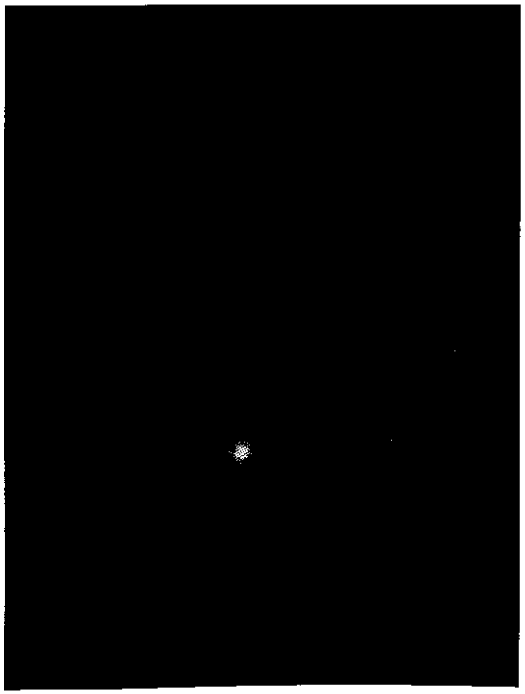
This is particularly valuable with fireballs which may be candidates for meteorite dropping. If you see a really brilliant object, then send in a report without delay, as it may possibly lead to the recovery of a meteorite.

The naked eye observer is also ideally suited to the observation of Aurorae and the Zodiacal Light, though a very clear atmosphere is needed for the Zodiacal Light, and aurorae are of course best seen from high latitudes. Note the forms, colours, times and any unusual phenomena.

I have said little or nothing here about photography or spectroscopy of objects in the Solar System, because this booklet is aimed at the complete beginner; but once you have mastered the fundamentals, you will find that the scope is almost unlimited.

Comets

Let us hope that interest in comets will not fall away in the post-Halley era, because studies of these wraith-like bodies are of immense interest. Unfortunately most of the periodical comets are so faint that they will be beyond the range of the beginner, and spectacular comates have been rare of late. The main scope is, therefore, comet-hunting, and this involves sweeping the sky with a wide field telescope or special binoculars (even ordinary binoculars can be pressed into service). But it is essential to know the sky really well, and this takes time and patience, because star clusters and nebulae look remarkably 'cometary' and it is only too easy to be deceived.



Comet Swift-Tuttle photographed on the night of 20 November 1992. Photo by Michael Stecker. This comet is the parent of the Perseid meteor shower.

Recording

A few comments may not be out of place here, though everyone is bound to have their own methods. At least it is, in my view, wise to keep a different observing book for each subject – one for the Moon, one for variable stars and so on – as otherwise things tend to become confused. Always record your observations at once; the temptation to 'leave it until tomorrow' is certain to result in errors. Also, never record anything as definite unless you are absolutely certain about it. In case of doubt, mark it as 'dubious'. morever, remember to attach the essential data to every observation – date, time, name of observer, type of telescope, magnification and seeing conditions. Finally, never send away an original observation. It may well be lost in the post, or mislaid in some way. I strongly advise you to make copies, and distribute those.

The stars

Now let me turn to the stellar sky. Again I can draw upon my own experience – and when I was very young I adopted a policy which I found to be very helpful.

Many years ago, the British Astronomical Association used to have what was termed a "Star Colour Section". The aim was to observe all the bright stars and determine their colours, bearing in mind that for this sort of estimation a reflector is always better than a refractor; all sorts of factors have to be taken into account – altitude, scintillation and so on. At the beginning of the century there was some value in this. Today this is no longer so, but at the age of about ten I decided to make a survey. With the naked eye with binoculars and with my 3-inch refractor, I systematically observed every star above magnitude 5, and noted its colour as I saw it. The results were of absolutely no scientific value – but by the time I had finished, a couple of years later, I really knew my star patterns, and I had also made myself familiar with almost all the clusters and nebulae within my range. Given the same circumstances, I would do exactly the same thing again; and I recommend it to you.

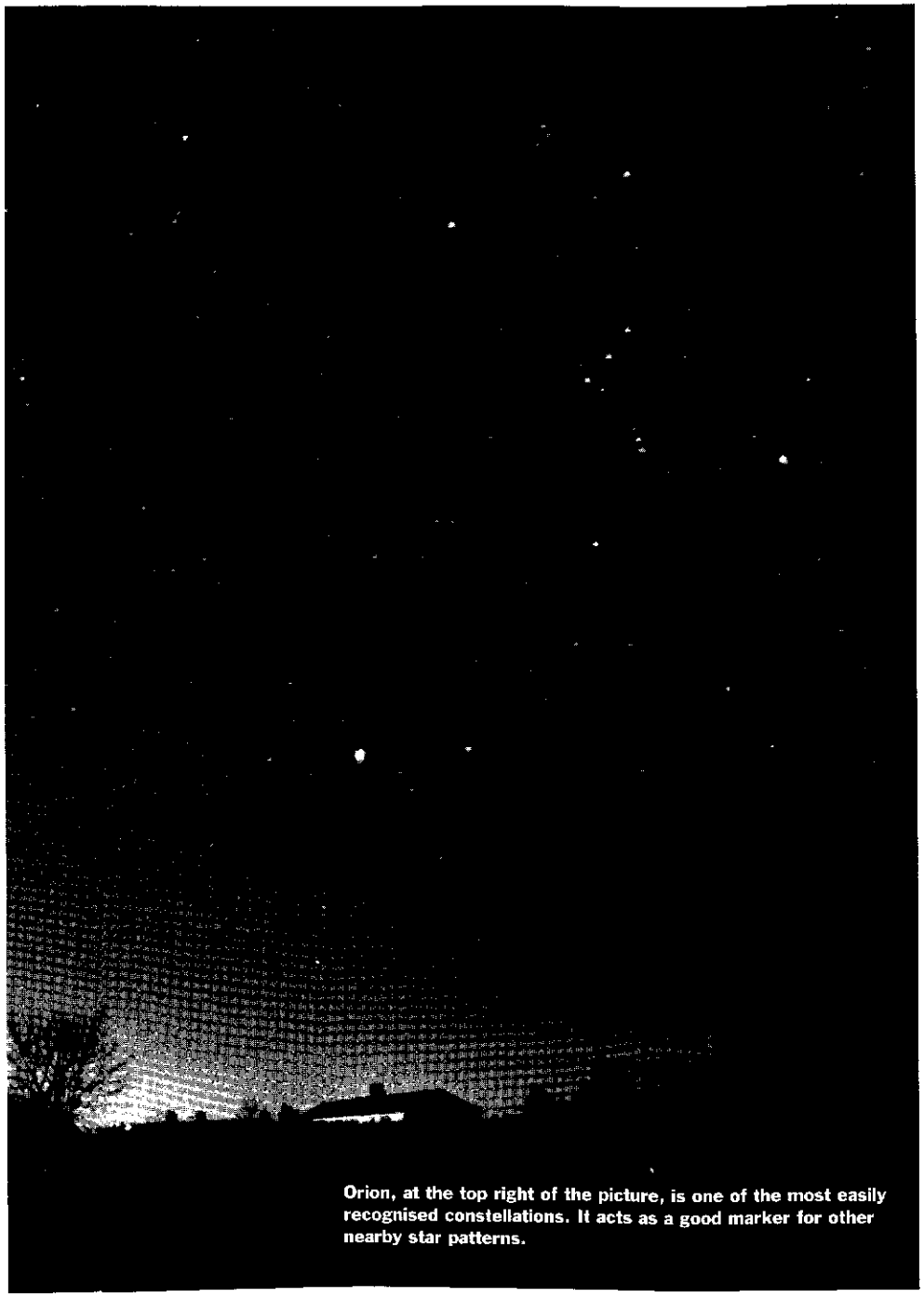
Double stars are interesting to look at, though measuring separations and position angles is no task for the beginner. Variable stars, however, have immense scope, and variable star work is now one of the most important branches of modern amateur astronomy.

The basic principle is to select your variable, and estimate its magnitude by comparing it with nearby stars of constant brightness. It is wise to select several comparison stars, some obviously brighter than the variable and some fainter; with care, the results can be accurate to a tenth of a magnitude.

Some variable are suited to naked eye observation. To give just one example; Gamma Cassiopeiae, the middle star of the 'W' of Cassiopeia, is an erratic variable star, which is usually around magnitude 2.2, but has been known to rise to 1.6 or sink to 3.2. There is a nearby comparison star, Beta (2.3) and also Delta (2.7); naked eye estimates may be fruitful. The neighbouring star Alpha Cassiopeiae is also a suspected variable. Because these three are near neighbours, there is no problem with 'extinction', or the dimming of light according to a stars altitude – as is evident, say with Betelgeux in Orion, which has to be compared to stars such as Aldebaran and Procyon which are usually very different in altitude.

Binoculars can be very useful for variable star work. There are many within range – R Coronae Borealis at its usual brightness is a good example. Telescopically, the scope is wide, and there are so many variables that no observer can cover them all.

There are two main methods of estimation. One is Pogson's step method, where the observer trains himself to estimate differences of a tenth of a magnitude; the other is 'fractional', where two comparisons are selected, one brighter than the variable and the other fainter, so that the variable is given in 'steps' between the two. I will not go further into details here, but it is true that a moderate telescope can provide a great deal of fruitful work – particularly with irregular or eruptive variables. For more accurate observation a photometer is needed, but this again takes us beyond the realm of the beginner.



Orion, at the top right of the picture, is one of the most easily recognised constellations. It acts as a good marker for other nearby star patterns.

Then, of course, there is nova hunting. Bright novae can appear without warning – remember Nova Cygni 1975! Nowadays, amateurs also hunt for supernovae in external galaxies with great success, but a thorough knowledge of the sky is essential, together with a telescope of at least 6-inch aperture and probably more.

I am well aware that these notes have been very sketchy, and that much has had to be left out. But to sum up, the procedure I recommend is straightforward enough.

First, do some reading and learn the basic facts. Next, take an outline star map, go outdoors on clear nights and learn your way around the sky. Join an astronomical society – either a local one, the British Astronomical Association or both. There is also the Popular Astronomical Society. Borrow or buy a pair of binoculars, and extend your practical knowledge. Then, if you are still interested, consider a telescope – not a very small one, but something which will last you a lifetime. Spread over a long period, the initial, non-recurring outlay of £400 or so does not seem excessive. All success to you – and happy star gazing!

Dr Patrick Moore CBE

Select bibliography

Astronomical literature is now so extensive that all that can be done here is to list a few good books, mainly those aimed at the practical observer. As a general introduction to astronomy, *Colours of the Stars* by Paul Murdin and David Malin (Cambridge, 1984) is particularly good, and for the reader who wants to go more deeply into the subject, *Universe* by William Kaufmann (Freeman, 1988) is excellent in every way. The *Yearbook of Astronomy*, published annually by Sidgwick and Jackson, gives notes for each year, together with articles and lists of astronomical societies.

Norton's Star Atlas (edited by G.E. Satterthwaite, published by Gall and Inglis, is still invaluable, and almost every amateur uses it. (Copies can often be picked up second-hand.) For binocular observers, there is *Exploring the Night Sky with Binoculars*, by Patrick Moore (Cambridge, 1988).

The three handbooks by Burnham – *Burnham's Celestial Handbook*, published in 1978 – are for the serious observer. The Webb Society handbooks (Enslow, 1980) are very useful indeed. For southern observers there is *Astronomical Objects for Southern Telescopes*, by E. Hartung (Cambridge, 1984). The brightest nebulae and clusters are described in detail in the *Messier Album* by J. Mallas and E. Kreimer (Cambridge, 1978).

For the Moon, Henry Hatfield's *The Amateur Astronomer's Photographic Lunar Atlas* is unrivalled. Unfortunately it is out of print, but copies can still be found, and the maps are obtainable from the British Astronomical Association. Bertrand Peek's *The Planet Jupiter* (Faber, 1981) remains the classic for Jupiter observers.

Astronomy Now, Britain's leading astronomy enthusiast's magazine, is published by Intra Press, Intra House, 193 Uxbridge Road, London W12 9RA. Tel: (081) 743 8888 Fax: (081) 743 3062. Email: prognow@cix.compulink.co.uk or 100010.517@compuserve.com. Available from all good newsagents. UK and worldwide subscription rates on application.